Suomi NPP and JPSS Pre-Launch Test Data Collection and Archive

Michael Denning[1], Richard Ullman[2], Bruce Guenther[3], Heather Kilcoyne[4], Charles Chandler[5], Julie Adameck[6]

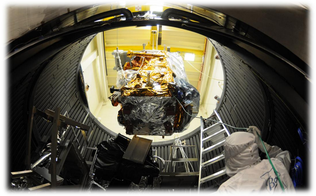
[1]Integrity Applications Incorporated, Chantilly, VA, [2]NASA Goddard Space Flight Center, Greenbelt, MD, [3]Stellar Solutions, Inc., Chantilly, VA
[4]NOAA / NESDIS / JPSS, Greenbelt, MD, [5]Muniz Engineering, Inc., Seabrook, MD, [6]Adameck Consulting LLC, Alexandria, VA

Overview

During the development of each Suomi National Polar-orbiting Partnership (Suomi NPP) instrument, significant testing was performed, both in ambient and simulated orbital (thermal-vacuum) conditions, at the instrument factory, and again after integration with the spacecraft. The National Polar-orbiting Operational Environmental Satellite System (NPOESS) Integrated Program Office (IPO), and later the NASA Joint Polar Satellite System (JPSS) Program Office, defined two primary objectives with respect to capturing instrument and spacecraft test data during these test events.

1. Dissemination of test data and auxiliary documentation to a distributed network of scientists, to permit timely production of independent assessments of data quality and test progress.
2. Preservation of test data and documentation in a catalogued government archive for the life of the mission, to aid in the resolution of anomalies and to facilitate the comparison of on-orbit instrument operating characteristics to those observed prior to launch.

In order to meet these objectives, Suomi NPP pre-launch test data collection, distribution, processing, and archive methods included adaptable support infrastructures to quickly and completely transfer test data and documentation from the instrument and spacecraft factories to sensor scientist teams on-site and around the country. These methods were unique, effective, and low in cost. These efforts permitted timely data quality assessments and technical feedback from contributing organizations within the government, academia, and industry, and were critical in supporting timely sensor development.

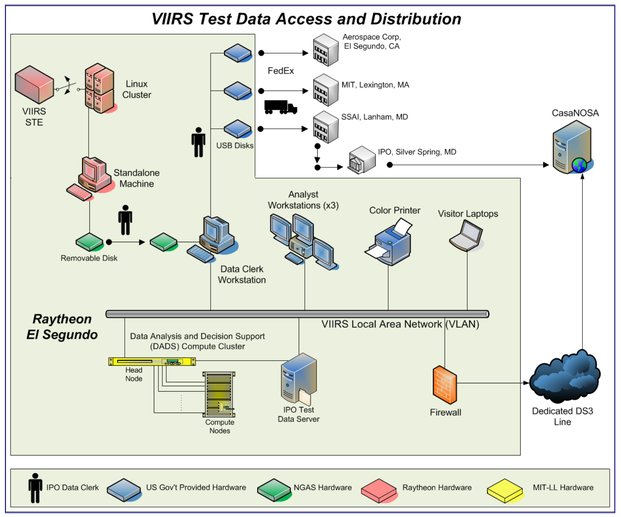


Suomi NPP spacecraft being lowered into the "Brutus" thermal-vacuum test chamber at the Ball Aerospace & Technologies Corp (BATC) facility in Boulder, CO

In parallel to data distribution to the sensor science teams, pre-launch test data were transferred and ingested into the central Suomi NPP calibration and validation (cal/val) system, known as the Government Resource for Algorithm Verification, Independent Testing, and Evaluation (GRAVITE), where they will reside for the life of the mission. As a result, data and documentation are available for query, analysis, and download by the cal/val community via the command-line GRAVITE Transfer Protocol (GTP) tool or via the NOAA-collaborative website "CasaNOSA". Instrument and spacecraft test data, telemetry, and ground support equipment information were collected and organized with detailed test procedures, logs, analyses, characterizations, and reports. This 45 Terabyte archive facilitates the comparison of on-orbit Suomi NPP operating characteristics with that observed prior to launch.

JPSS-1 test data collection and archive plans are currently under development. These plans will build on the methods used during Suomi NPP test campaigns.

VIIRS Test Data Capture & Distribution



During Suomi NPP VIIRS testing, the instrument vendor, Raytheon Space and Airborne Systems, El Segundo, CA, directed test data from the high-bay to a Raytheon owned and operated Linux cluster in near real-time. Raytheon provided the government with access to test data on this cluster via a read-only workstation. For security reasons, an air gap existed between this read-only workstation and government equipment. In place of the air gap, the government formed an on-site data clerk team who transferred test data to an on-site government data server via removable external hard disks. Raw sensor data, in Consultative Committee for Space Data Systems (CCSDS) packet format, were distributed to the analysis teams via three methods.

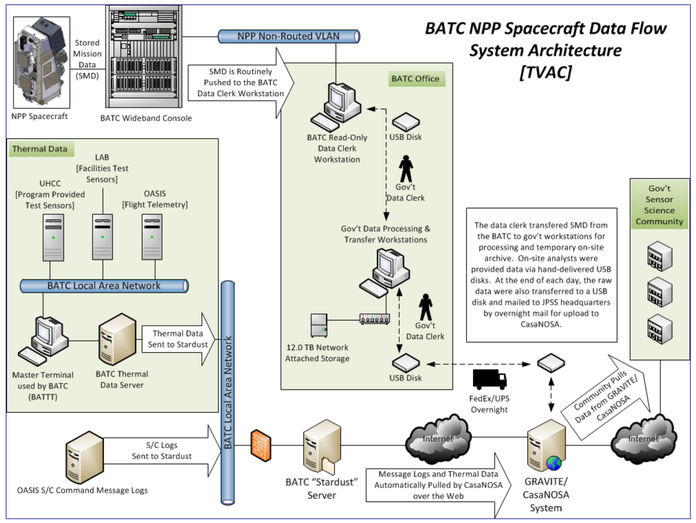
1. On-site sensor analysts had access to data over a secure virtual local area network (VLAN) and could commence their work immediately.
2. The data clerk populated portable USB disks with sensor data, and shipped them via overnight courier service to off-site analysts.
3. Data were also automatically transferred to NOAA headquarters via dedicated DS3 (Digital Signal 3) line. Once at NOAA headquarters, data were made available to analysts around the country via the CasaNOSA website, NOAA's test data repository serving Suomi NPP sensor scientists and cal/val teams.

During thermal-vacuum, the data clerks transferred several gigabytes of data at thirty-minute intervals – 24/7 for 111 straight days.

Plans for VIIRS JPSS-1 are proposed to electronically transfer test data between Raytheon's data server and an on-site government data server. GRAVITE also replaces CasaNOSA as the off-site government archive.

Suomi NPP Spacecraft Environmental Test Data Capture & Distribution

- During spacecraft-level environmental testing, after all instruments were integrated, the government assembled a data clerk team to support test data collection for critical dynamics, electromagnetic interference (EMI), and thermal-vacuum events.
- During those test events, BATC test engineers performed spacecraft solid state recorder (SSR) dumps at an interval of once per orbit (102 minutes). The result was a single file up to 43 Gigabytes in size.
- Each file contained randomized Channel Access Data Units (CADUs) that were not Reed-Solomon error corrected. The data clerk retrieved these files from a BATC-provided read-only workstation, transferred, and processed the data with custom software on local government hardware to produce files of corrected and contiguous CCSDS packet streams by instrument.
- Portable disks were used to transfer raw and processed packet streams to on-site and off-site analysts, and to NASA headquarters where they were uploaded to CasaNOSA. Thermal data, spacecraft command message logs, and other ground support and auxiliary data and documentation were electronically pushed to CasaNOSA from the factory over the Internet.



Test Data Archive

VIIRS test procedures, shift logs, instrument logs, and test reports were organized with their respective test datasets in the government archive for easy access.

	13	14			hardware assembly for changes to the software made after the initial software validat	
ETP.641: Flight Software Load and RATP for Version for 0x400F (Pre-TVAC)	2009-04-03	2009-04-05	Pre-TVAC	ETP	This procedure will install Flight Software 0x400F for VIIRS F1. Then will perform regression acceptance test of the 400E and 400F flight software in accordance with TP-154640-352.	Complete
SI.4 Part 2: Limited	2009-04-07	2009-04-07	Pre-TVAC	Sensor Integration	To verify the proper operation of the VIIRS command and telemetry for all command telemetry interfaces between the EM and OMM (i.e. motor and heater controls) for all cross-strapping configurations.	Complete & Populated
SI-5 Part 1.1: Electronics Self Test (A and B side, Pre-TV)	2009-04-07	2009-04-07	Pre-TVAC	Sensor Integration	The objectives of this test are to verify the following :SRV0089 - Verify functionality of data acquisition path from Readout Integrated Circuits (ROIC) to Digital Number (DN) output (detector's disconnected)	Complete
SI-6 Parts 1.1, 1.3 and 2: Noise Test (A and B side)	2009-04-07	2009-04-09	Pre-TVAC	Sensor Integration	SI-6: Part 1.1 makes basic measurements of sensor noise level. Part 1.2 makes measurements of sensor noise level for a set of special operating conditions. Part 1.3 makes basic	Complete

SI-5 Part 1.1: Electronics Self Test (A and B side, Pre-TV)

Purpose of Test:	The objectives of this test are to verify the following: SRV0089 - Verify functionality of data acquisition path from Readout Integrated Circuits (ROIC) to Digital Number (DN) output (detector's disconnected) and measure response & noise with several self-test input settings (ramp base and step values). Health check: Repeatability of resulst to same self-test input after baseline established. Demonstrate adaptability of Direct current (DC) Restore algorithm/process. Measure electronic read noise (detector disconnected and self-test off). Measure response to self-test input ramp that will put the detector channel into saturation. Demonstrate functionality of Self-Test Subtract Mode for Long Wave Infrared (LWIR) Focal Plane assembly (FPA). Demonstrate capability to determine and subtract detector current in amount approx. equal to dark current and photon current present when viewing spaceview		
Start Date and Time:	2009-04-07 at 1906	Test Status:	Complete
End Date and Time:	2009-04-07 at 2237	Test Type:	Sensor Integration
Instrument and Test Phase:	FU1 - Pre-TVAC	Shift Report(s):	[edit] Viirs_FU1_Shift_Log_2009_04_07_2nd.doc
Data Master(s):	[edit] SI-5_2009-04-08_Datamaster.pdf	Raytheon Test Report and EFR(s):	[edit]
Test Log(s):	[edit] SI-5_2009_04_08_TestLog.xls	Reference Documents:	[edit] tp154640-244_SI-5_Electronics_Self-Test.pdf
UAID(s):	[edit] UAID: u3103173, u3103174	Number of Collects, Scans per Collect: 008 Collects; 128 Scans Per Collect, 008 Collects; 128 Scans Per Collect	

Basic test information | Binary test data files | Instrument log | As-run test procedure | Shift report

CrIS & OMPS

During Suomi NPP Cross-track Infrared Sounder (CrIS) instrument-level testing at the ITT Corporation facility in Fort Wayne, Indiana, visiting on-site government analysts were provided access to a self-service, ITT workstation with read-only access to near real-time generated test data. Analysts transferred the test data to their portable USB disks for local analysis and later for priority overnight shipment to NOAA headquarters and to off-site analysts at other locations. Once at NOAA headquarters, test data and documentation were uploaded and catalogued in the CasaNOSA system. Plans for CrIS JPSS-1 replace the human-in-the-loop element with electronic distribution of test data from the factory to GRAVITE.

During Ozone Mapper Profiler Suite (OMPS) instrument-level testing at the Ball Aerospace and Technologies Corporation (BATC) factory in Boulder, Colorado, test data were electronically pushed from the factory over the Internet to a government server at NOAA headquarters. New data were transferred once per day, off-hours, via an automated cron task on a BATC test data server that initiated an rsync data comparison and push over remote secure shell. Once the data were transferred to the government server, they were ingested to CasaNOSA and made available to the analyst community for immediate download. A similar strategy is currently employed for OMPS JPSS-1 test data distribution; CasaNOSA has been replaced by a GRAVITE system and data transfers occur at higher frequencies.

Conclusions & Future Work

Although network bandwidth, disk storage, and processing power have dramatically increased over the years, so have the data rates of weather and climate sensors such as those on Suomi NPP. The task of collecting, disseminating, and archiving test data, complete with auxiliary data and documentation, is by no means trivial. We have described our methods for collection, distribution, and archive of sensor and spacecraft test data, to support timely analysis during instrument development, and rapid post-launch cal/val via the production of a comprehensive test data archive. For instrument-level VIIRS and spacecraft-level testing, staffing the project with around-the-clock data clerks proved to be the most efficient use of program resources. They were able to support scientists in searches for data and documentation in a way not possible to be automated.

Plans for JPSS-1 test data collection and archive support architectures are currently under development, building on methods used and lessons learned during Suomi NPP test events. JPSS-1 instrument-level environmental testing is scheduled for 2013 and 2014. Integrated spacecraft testing will follow in 2015 and 2016.

In parallel to these planning activities, all test data previously archived on CasaNOSA is being migrated to GRAVITE, the JPSS cal/val support infrastructure system. The GRAVITE Data and Information Portals will replace the CasaNOSA system in 2013.

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